Overview of WG1 Activity in the Fire Engineering

International Symposium
23 – 25 October, Valletta - Malta

František Wald
Czech Technical University in Prague

List of Contents

- WG1 Fire resistance
- Quality of today prediction
  - Presprictive based aproach
  - Performance based aproach
  - Fire test Mokrsko 2008
- WG1 Activity after Malta Symposium

WG1 Delft Meeting 17- 18 November 2006
Presentations of national projects

1. Ian Burgess, UK: 'Robustness of connections in fire'
2. Ulf Wickström, Sweden: 'Heat transfer from fires to structures'
3. Milan Veljkovic, Sweden: 'Behaviour of of thin-walled steel columns in fire'
4. Aldina Santiago, Portugal: '3D behaviour of steel joints under a natural fire and its influence on structural response'
5. Nuno Lopes, Portugal: 'Behaviour of stainless steel structural elements in case of fire'
6. Beatrice Faggiano, Italy: 'Post-earthquake Fire Resistance of Moment Resisting Steel Frames'
7. Gordon Geißler, Germany: Aspects of material modelling of wood and concrete
8. Raul Zaharia, Romania: Fire design of composite steel-concrete columns
9. Kimon Thomopoulos, Greece: 'Aluminium structures'
10. Zenon Drabowicz, Poland: 'Pre-stressed bolted steel connections under high temperature loading'
11. Arnoud Breunese, The Netherland: 'Presentation of Efectis Nederland'
12. Martin Gillie, UK: 'The Fire Safety Engineering Group in University of Edinburgh'
13. Roland Abspoel, The Netherland: 'Sensibility of Plate Girders in relation to fire'
14. František Wald, Czech Republic: 'Fire test on structure in Ostrava, May 2006'

Main Research Topics of National Projects from WG1 Delft Meeting

- Fire modeling
- Connection modelling
- Member behaviour
- Material simulation
- Fire after earthquake
- Global analyse

WG1 Session at Praha Wordshop

March 30-31, 2007

- Composite steel to concrete structures, *Tan Kang Hai*
- Connection modelling, *I. Burgess*
- Members behaviour, *N. Lopes*
- Fire after earthquake, *B. Faggiano*
- Global analyses, *M. Gillie*

- State of the art and invitation to poster session, *Y. Wang*

- Poster session

WG1 Technical Sheets

1. Introduction to fire design, *F. Wald & I. Burgess*
2. Overview of fire design, *Y.C. Wang, J.M. Fransen, M. Heinisuo, F. Wald & I. Burgess*
3. Heat transfer analysis, *Y.C. Wang & F. Wald*
4. Fire design in Europe, *M. Heinisuo at al.*
5. Mechanical properties of materials, *D. Pintea, R. Zaharia, M. Kaliske, G. Kaklauskas, D. Bacinskas, V. Gribniak, Á. Török & M. Hajpál*
6. Thermal properties of materials, *D. Pintea, R. Zaharia, M. Kaliske, G. Kaklauskas, D. Bacinskas, V. Gribniak, Á. Török & M. Hajpál*
7. Global modelling of structures in fire, *M Gillie, I Burgess, J-M. Franssen, L. Kwasniewski, Y. Wang*
8. Structural member behaviour and analysis in case of fire, *N. Lopes, P. Vila Real, B. Uppfeldt, M. Veljkovic, L. Simões da Silva, J-M. Franssen, A. Bouchaïr, J-P. Muzeau, O. Vassart, D. Bacinskas, G. Kaklauskas, V. Gribniak, M. Cvetkovska, L. Lazarov, E. Nigro & G. Cefarelli*
9. Structural member design in case of fire, *N. Lopes, P. Vila Real & A. Bouchaïr*
10. Behaviour of steel and composite joints in fire, *I. Burgess, A. Santiago & F. Wald*
11. Component-based approaches of steel and composite joints in fire, *I. Burgess, A. Santiago & F. Wald*
12. Design procedures for steel and composite joints in fire, *I. Burgess, A. Santiago & F. Wald*
13. Risk and management in case of fire after earthquake, *B. Faggiano, M. Esposto, R. Zaharia & D. Pintea*
14. Structural analysis and design in case of fire after earthquake, *B. Faggiano, M. Esposto, R. Zaharia & D. Pintea*
15. Robustness under fire, *Y.C. Wang & F. Wald*
16. Fire damaged structures, *Y.C. Wang, F. Wald, Á. Török & M. Hajpál*

WG1 Technical Sheets - basic

1. Introduction to fire design, *F. Wald & I. Burgess*
2. Overview of fire design, *Y.C. Wang, J.M. Fransen, M. Heinisuo, F. Wald & I. Burgess*
3. Heat transfer analysis, *Y.C. Wang & F. Wald*
4. Fire design in Europe, *M. Heinisuo at al.*
5. Mechanical properties of materials, *D. Pintea, R. Zaharia, M. Kaliske, G. Kaklauskas, D. Bacinskas, V. Gribniak, Á. Török & M. Hajpál*
6. Thermal properties of materials, *D. Pintea, R. Zaharia, M. Kaliske, G. Kaklauskas, D. Bacinskas, V. Gribniak, Á. Török & M. Hajpál*
7. Global modelling of structures in fire, *M Gillie, I Burgess, J-M. Franssen, L. Kwasniewski, Y. Wang*
8. Structural member behaviour and analysis in case of fire, *N. Lopes, P. Vila Real, B. Uppfeldt, M. Veljkovic, L. Simões da Silva, J-M. Franssen, A. Bouchaïr, J-P. Muzeau, O. Vassart, D. Bacinskas, G. Kaklauskas, V. Gribniak, M. Cvetkovska, L. Lazarov, E. Nigro & G. Cefarelli*
9. Structural member design in case of fire, *N. Lopes, P. Vila Real & A. Bouchaïr*

WG1 Technical Sheets - special

10. Behaviour of steel and composite joints in fire, *I. Burgess, A. Santiago & F. Wald*
11. Component-based approaches of steel and composite joints in fire, *I. Burgess, A. Santiago & F. Wald*
12. Design procedures for steel and composite joints in fire, *I. Burgess, A. Santiago & F. Wald*
13. Risk and management in case of fire after earthquake, *B. Faggiano, M. Esposto, R. Zaharia & D. Pintea*
14. Structural analysis and design in case of fire after earthquake, *B. Faggiano, M. Esposto, R. Zaharia & D. Pintea*
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Legislation

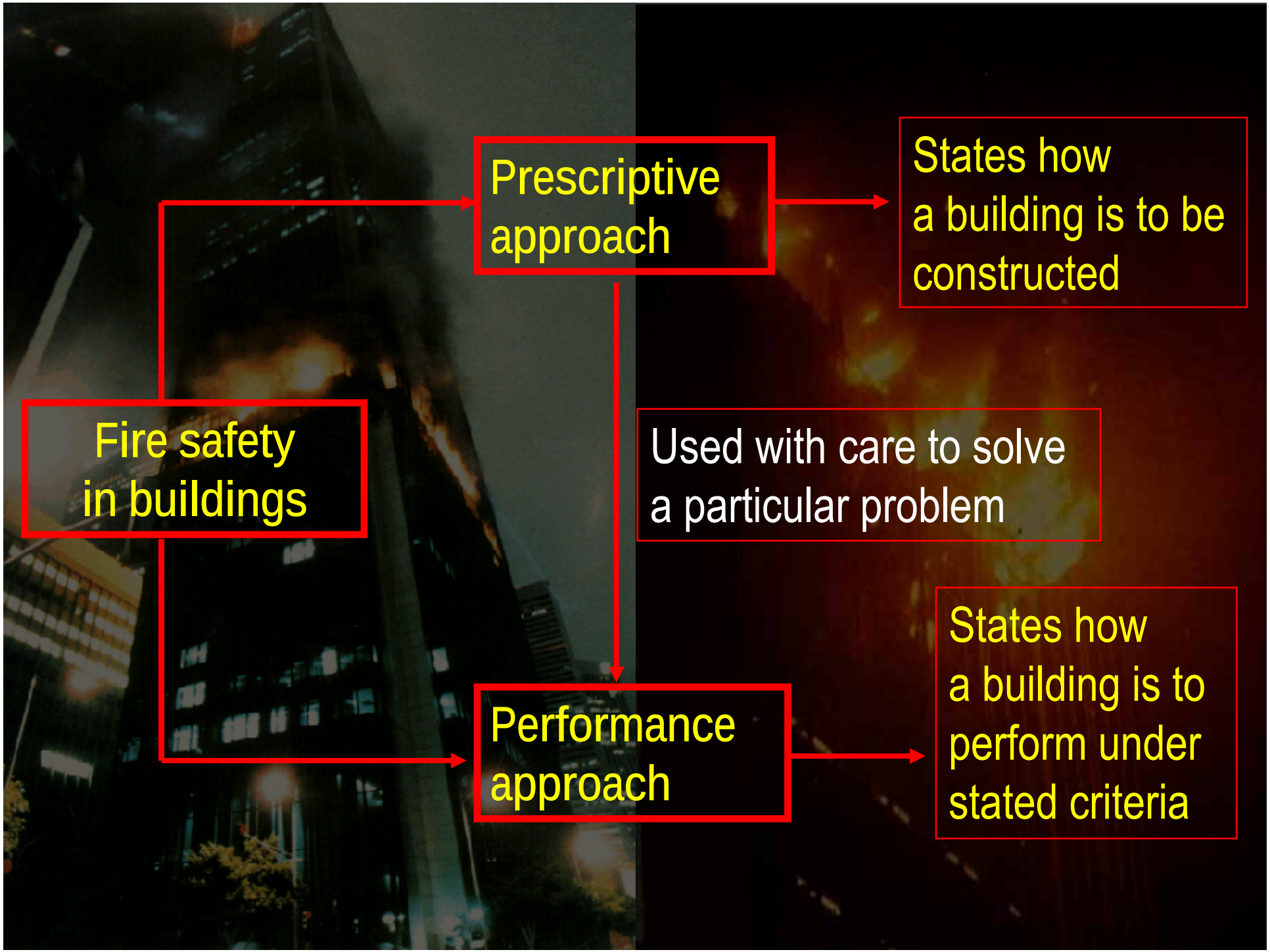
EU Construction Products Directive,

Council Directive 89/106/EEC, from 21.12. 1988

The Regulations relating to fire cover:

- Load-bearing capacity
- Spread of fire and smoke
- Spread of the fire to neighbouring construction
- Occupants can leave
- Safety of rescue teams

Covers life safety only !!!!

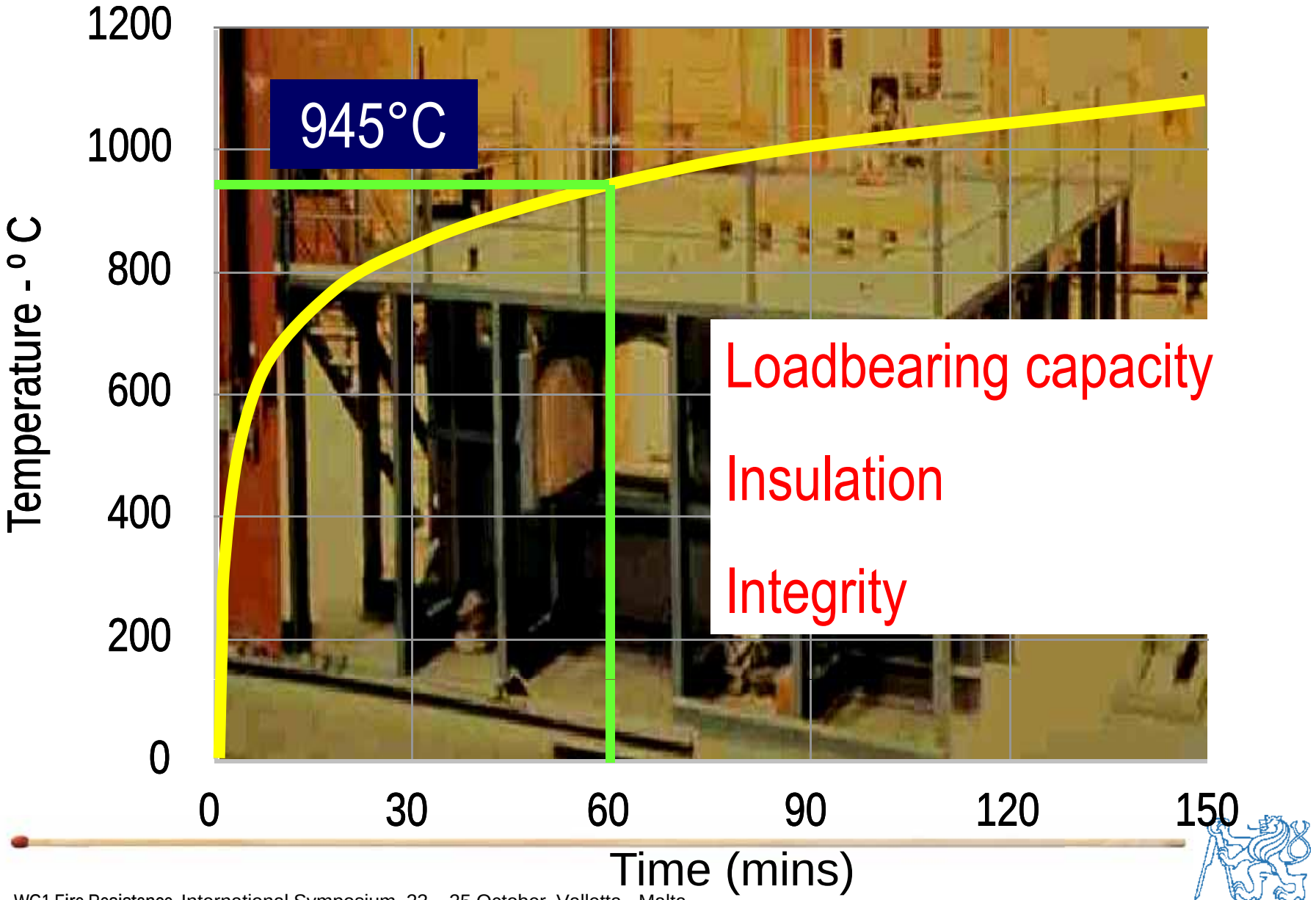

Fire safety in buildings
Prescriptive approach
States how a building is to be constructed
Used with care to solve a particular problem
Performance approach
States how a building is to perform under stated criteria

Example of Fire Resistance Periods

	Height of Building (m)			
	<5	<18	<30	>30
Residential (Non Domestic)	30	60	90	120
Offices	30	60	90	+ Sprinklers
Shops, Commercial, Assembly	60	60	90	
Industrial & Storage	60	90	120	
Car Parks - Open	15	15	15	15

60 min fire resistance means
that the elements will survive 60 min in a standard fire test

Standard Fire Resistance



History of the Standard Fire Test

- 1890's early attempts
  at establishing structural fire behaviour
  at the behest of insurance companies
- 1917 First US Standard produced
- 1932 First Edition of BS476 (UK)
- 1933 E119 (US) produced
- 1985 ISO 834
- 2003 EN 1991-1-2
- BSEN 1363-1

118 years of testing ! & still going

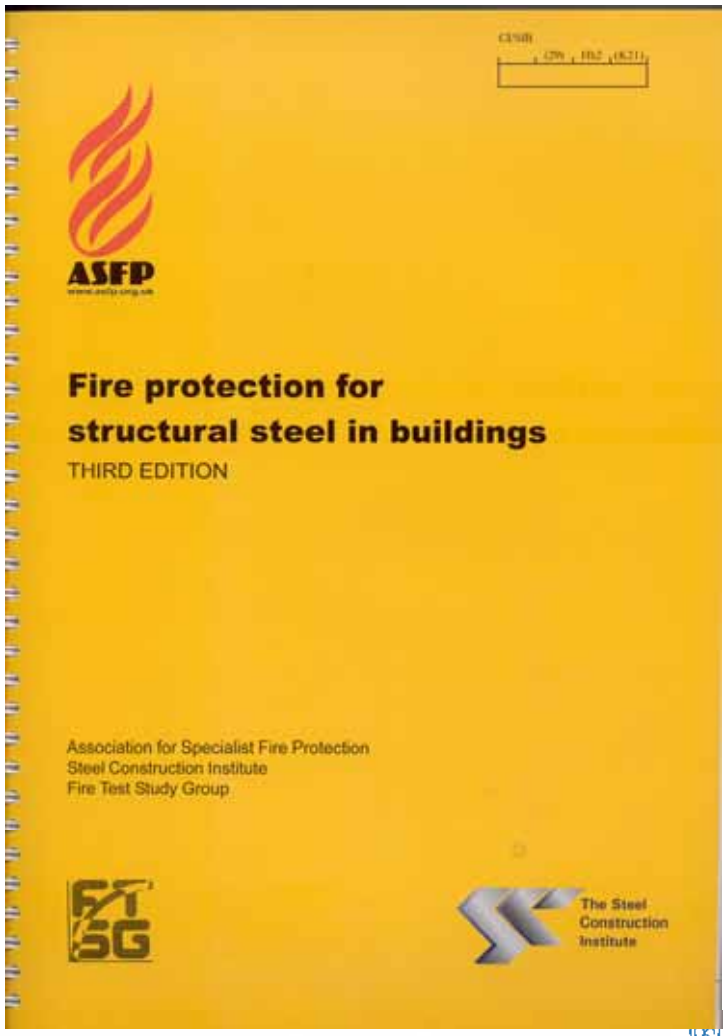
Classified Fire Protection

Thickness of protection dependent on

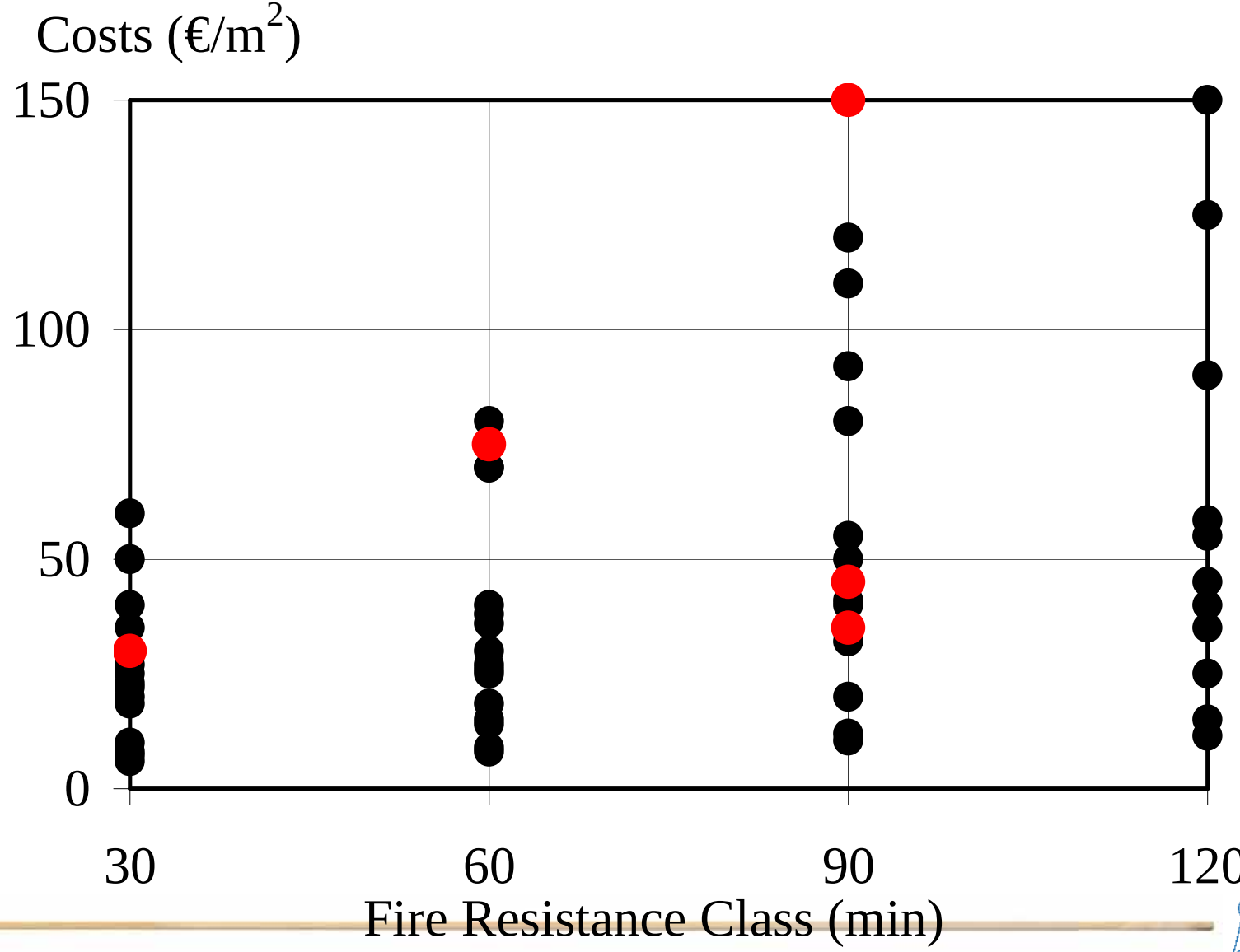
- Fire resistance class
- Section factor

Simple Prescriptive Rules

– deemed to satisfy



Costs for Passive Fire Protection



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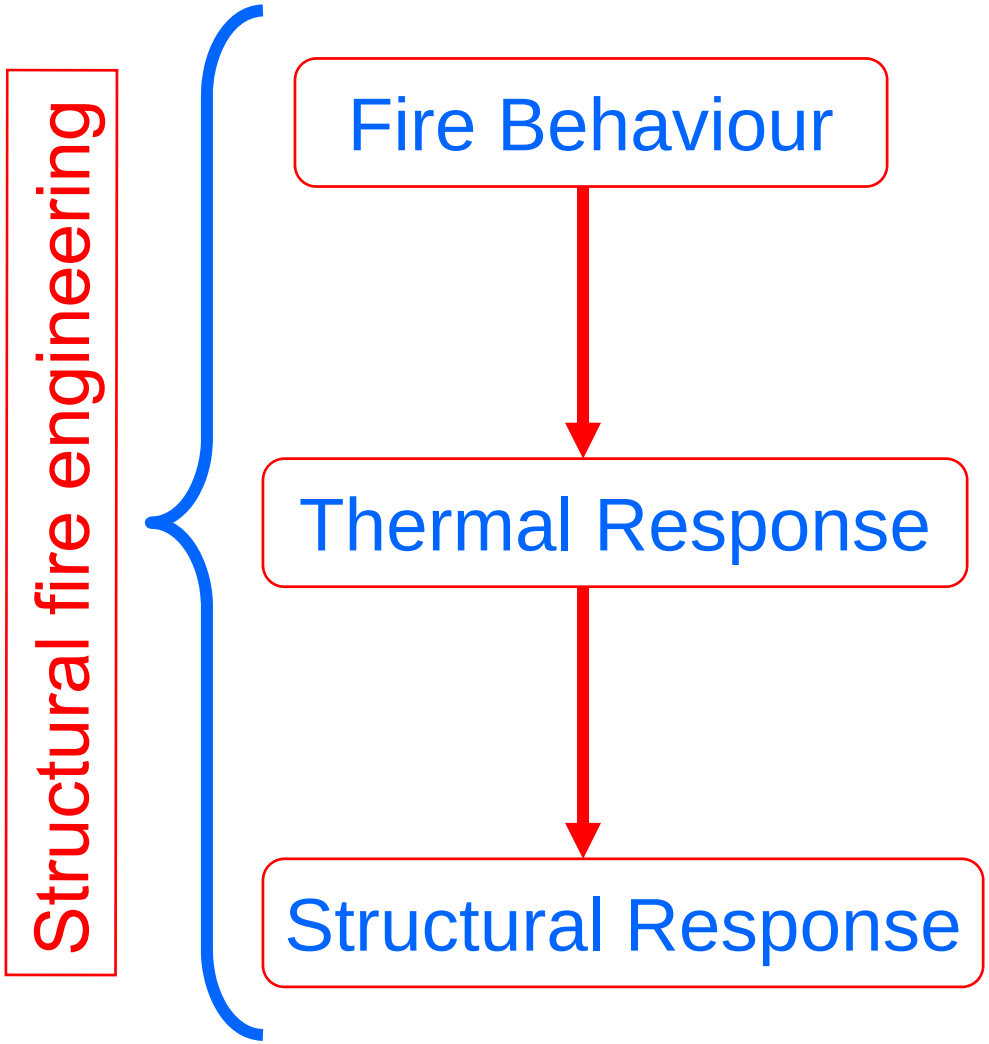

Structural fire engineering
Fire Behaviour
Thermal Response
Structural Response

Advantages

Actual behaviour and robustness of the building

Optimum design to be determined taking into account life safety, financial, impact and environmental issues

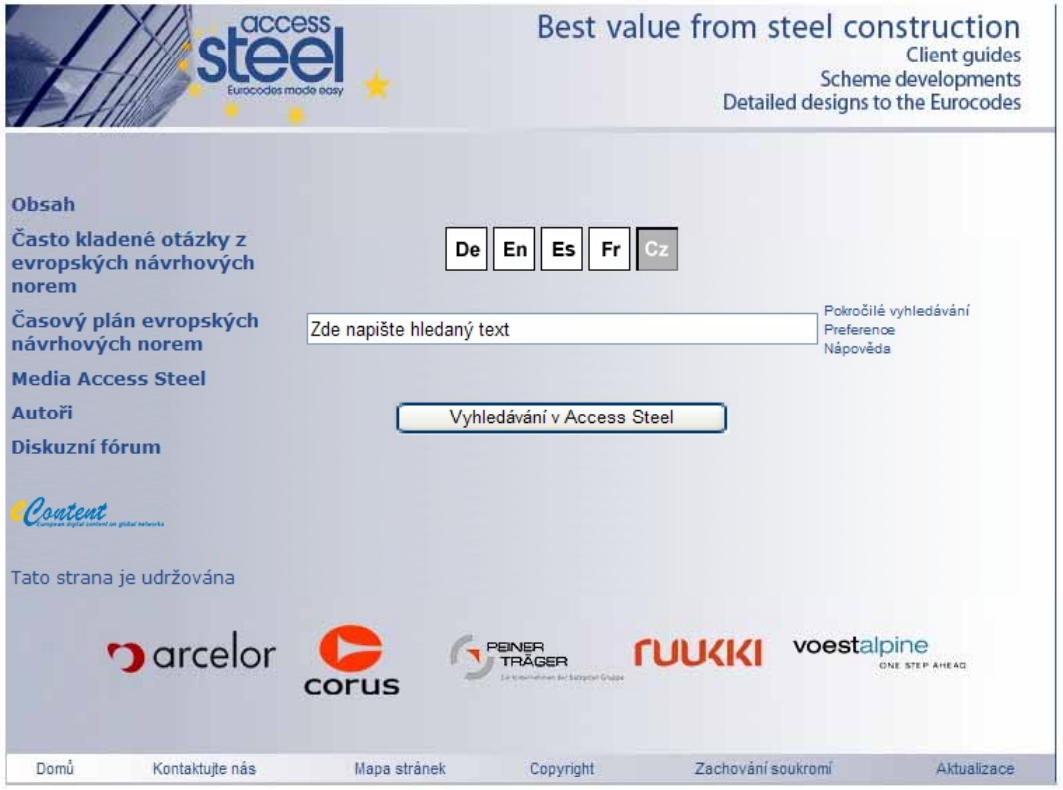
Part of an assessment of multiple risks (earthquake followed by a fire)

Disadvantages

- More design effort
- Requires multi-discipline skills
- Design can be complicated
- Change of building use
  may make the fire design invalid

Tool Access Steel on Internet

- Hypertext engine
- Support EC3, EC4
  - Case study
  - Design procedures
  - Flow charts
  - NCCI
  - Worked examples
  - Tables



- Simple fire design
  - 30 % of lectures

Simple and Edvanced Fire Design
URL: Difisek.com

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Fire Test Mokrsko, 18 September 2008

Structure

Connection with Improved Fire Resistance

Mechanical Load

167 % resistance of plate at fire

Fire Load

111 % of adminostrative building

Fire starts

Angelina Beams

Concrete Wall

after fire -75 mm

After the Test

Fire Resistant Connection

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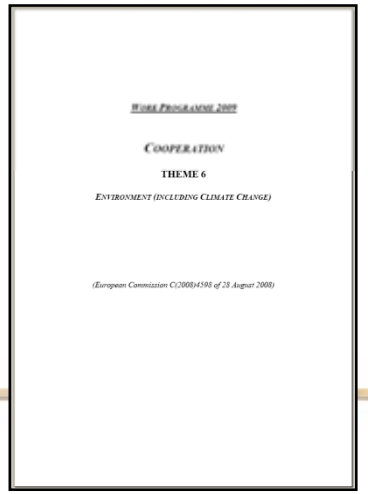
WG1 Activity after Malta Symposium

- The next activity of the WG1 will focus based on MOA more to:
  - Existing buildings
  - Cooperation to public authorities
- Ongoing project in the field
  - Benchmarks, Key studies
  - Future needs
- Preparation of EU project
  - Preparation of next COST action
  - 7th FW

WG1 Session at Malta Symposium

- Finalizing the Technical sheets
- Schedule for next 2 years

- 7FW
  - ENV.2009.3.2.1.2 Technologies for protecting cultural heritage assets from risks and damages resulting from extreme events, especially in the case of fires and storms


WORK PROGRAMME 2009

COOPERATION

THEME 6

ENVIRONMENT (INCLUDING CLIMATE CHANGE)

(European Commission C(2008)4598 of 28 August 2008)

International Conference

Prague, **19–20 February 2009**

APPLICATIONS OF STRUCTURAL FIRE ENGINEERING

95 Abstracts

URL: eurofiredesign.fsv.cvut.cz

Thank you
for your attention

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